onto the bronchial stump only. Therefore, we modified our technique for dealing with the residual space, either by obliterating the space with concomitant limited thoracoplasty or by covering the raw surface with the latissimus dorsi (muscle tent).[6] During the last 4 ½ years of this series, we did not encounter space problems in any patients.

Postoperative chemotherapy is as indispensable as preoperative chemotherapy. The purpose of resectional surgery is to remove the main lesions that harbor numerous organisms. This means that scattered nodular lesions and tiny cavities may be left behind. In this study, approximately ¾ of patients had some degree of lesions in the lungs on the opposite side. Hence, it is crucial to keep patients on multidrug regimens for a sufficiently long period in order to hold the bacilli at bay in these lesions. Our duration of postoperative chemotherapy is 2 years, either when patients have positive sputum at the time of surgery or when they have positive specimen culture results. We may shorten the duration of chemotherapy, provided that patients have achieved sputum conversion prior to surgery and have negative specimen culture results. However, the optimal duration of postoperative chemotherapy requires further investigation.

Our study includes several distinctive features. First, as we are affiliated with the Japan Anti-Tuberculosis Association, our institution is one of the most experienced centers for the treatment of multidrug-resistant tuberculosis in Japan. We have such a reliable laboratory that we can routinely perform drug susceptibility testing on first- and second-line drugs and levofloxacin. As we have all types of antituberculosis drugs on hand, we can create the best available multi-drug regimens that are individualized for each patient. Nevertheless, favorable results with adjuvant resectional surgery have been reported not only from developed countries, but also from developing countries where medical resources are limited.[13,14]

Second, we preferred to use gatifloxacin late in this series in expectation of its potent efficacy against tuberculosis bacilli.[15] Gatifloxacin has, however, been currently withdrawn from sale both in the United States and in Japan because of the increased risk of dysglycemia in humans. This necessitates alternate, newer fluoroquinolones. As we live in an era in which extensively drug-resistant tuberculosis exists, multidrug-resistant tuberculosis should be controlled by any means. An aggressive treatment approach to multidrug-resistant tuberculosis continues to be justified until a panacea for this refractory disease is available.

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Discussion

Dr Alain Chapelier *(Suresnes, France)*. Dr Shiraishi and colleagues reported their updated experience of patients with multidrug-resistant *Mycobacterium tuberculosis* (MDR-TB) who underwent adjuvant resectional surgery with no mortality and excellent outcome. Dr Shiraishi has to be congratulated for these results in a technically challenging group of patients and for his nice presentation.

Surgery was considered for the patients with persistent positive sputum and the patients with a high risk of relapse because of residual cavitary lesions. Among this latter group, a positive bacterial examination of specimen was observed in approximately one third of patients who were preoperatively culture-negative, and this is a strong argument for surgery.

In this series, resections were performed with extended use of the latissimus dorsi muscle flap to reinforce the bronchial stump, as it has been also recommended by others. You outline a significant reduction of postoperative complications in the recent period of your experience. No residual pleural space problem was observed in the late period of your study.

I have 3 questions. My first question is related to the additional thoracoplasty. In the situation of a large post-resection space after an upper lobectomy, extended or not to the upper segment of the lower lobe, would you now advocate it systematically?

Dr Shiraishi *(Tokyo, Japan)*. Yes, I would. In our series, we found that space problems often occurred after we performed

a bilobectomy or lobectomy plus segmentectomy of the lower lobe. To prevent the residual space, we have to close the residual space by concomitant limited thoracoplasty or a muscle tent. I think the important thing is that at first we put the latissimus dorsi just onto the bronchial stump, but in that case we found that the raw surface of the remaining lung was exposed to the pleural cavity and might cause a minor leak and result in residual space. So I think we have to remove some of the ribs to reduce the space and cover the raw surface of the lung with muscle flap.

Dr Chapelier. My second question is concerning the patients with bilateral lesions. Many of your patients had small nodular lesions in the contralateral lung at the time of preoperative assessment. In 2 patients, however, you performed a planned staged bilateral resection. Could you comment on your strategy for these patients?

Dr Shiraishi. The best candidate for surgical therapy was the patient who had limited lesions, for example, a cavity just in the right upper lobe or left upper lobe, but some patients had cavities in both lungs. In that case, if the patient had good pulmonary function and a cavity was just localized in both sides of the upper lobes, we were able to remove both lesions, so we performed planned staged bilateral resections. Also, if the cavity is very small (eg, 5 or 6 mm), maybe we can leave those lesions.

Dr Chapelier. Finally, your institution is clearly a referral center for the treatment of MDR-TB in Japan, and you point out in the article the extreme importance of your laboratory to assess the efficacy of all drugs preoperatively and postoperatively. Considering the incidence of MDR-TB in the population of west European countries, for example, the prevalence of newly diagnosed cases is 1.4% in France with a stability during the last 10 years, and with regard to the medical and surgical expertise required to reach the results you reported today, would you recommend that this combined treatment be done in only 1 or 2 centers in our countries?

Dr Shiraishi. I don't understand your question.

Dr Chapelier. Do you think these difficult cases have to be done in selected centers?

Dr Shiraishi. Oh, yes. Surgery should be done in very specialized and highly experienced centers.

Dr Chapelier. Thank you.

Dr Marvin Pomerantz *(Aurora, Colo).* I enjoyed your article. Your results parallel our series published in the *Journal* of 180 resections in 174 patients, which was in 2001. I have 2 questions. Two of 3 of your pneumonectomies were on the left side. Every series I have ever read shows that if you do a pneumonectomy for tuberculosis, it is more often on the left side. Why is that?

Dr Shiraishi. Some groups have termed it ''left lung syndrome'' in such patients with tuberculosis. The left lung has some anatomic characteristics. The left main bronchus is longer than the right main bronchus. That means more vulnerability to tuberculosis bacilli. So that's why a left-sided pneumonectomy is more often done than a right-sided pneumonectomy.

Dr Pomerantz. Well, I'm not sure that's right. I'm not sure what the answer is either, but it's possibly due to the upper and lower lobe bronchial takeoff being so close together. That's another option. No one has been able to give me a good explanation. You have a higher number of segmental resections than we had in our series. I always thought it was better to make a wider resection than just a segmental. We had several, but not the higher percentages you have.

Dr Shiraishi. We performed a segmentectomy only in patients with very tiny cavities or tiny nodular lesions. We usually do lobectomy because the cavity is bigger. So in our series, the patients who had a segmentectomy had very limited lesions.

Dr Pomerantz. My final question is, you had 2 bronchopleural fistulas. Were they in patients who had positive sputum at the time of surgery, and were they on the right side or the left?

Dr Shiraishi. If I recall correctly, one bronchopleural fistula occurred on the right side after pneumonectomy. The other bronchopleural fistula occurred after left upper lobectomy. Both patients had positive sputum at the time of surgery and comorbidities, such as diabetes. Those patients had bronchopleural fistula 1 or 2 years after surgery, and the bronchial stump was eroded by the relapse of multidrug-resistant strains, and that caused bronchopleural fistula.

Dr Nasser Altorki *(New York, NY).* I want to ask you a little bit about the segmentectomy. Are you advocating that patients with MDR-TB have a lobectomy even if anatomically a segment can be performed?

Dr Shiraishi. It depends on the patient's pulmonary functional reserve.

Dr Altorki. Assuming that the pulmonary examination allows you to do either of these operations, is a segmentectomy sufficient if you can get rid of gross disease, or do you have microscopic disease that requires a lobectomy be preferred?

Dr Shiraishi. We performed segmentectomy mostly on the left upper division or lingular. In patients with limited lesions, we can take whole lesions by performing a segmentectomy, not a lobectomy.

Dr Altorki. I ask because the seminal work by Churchill and Belsey described segmentectomy exactly in patients with tuberculosis, and I wonder if the fact that they have drug-resistant tuberculosis changes the treatment at all.

Dr Shiraishi. No, it won't.

Dr Altorki. Thank you for your answer.